RE-KEYABLE LOCK AND METHOD

BACKGROUND OF THE INVENTION

[0001] Most common locks are pin-tumbler cylinder locks or wafer-tumbler cylinder locks. Each of these locks contains a cylinder or plug which rotates within a housing or shell. In the pin-tumbler locks, pin holes containing top and bottom pin tumblers extend transversely through both the cylinder and the housing, and may be crossing the shear line, i.e. the boundary between the cylinder and the housing. The pin tumblers slide up and down within the pin holes defining a locked position and an unlocked position. When a pin tumbler crosses the shear line, the pin tumbler interferes with the rotation of the cylinder and the cylinder remains locked. When the correct key is inserted in the lock, the biting on the key contact the pin tumblers and force them to slide within their pin holes such that no pin crosses the shear line. The cylinder can then rotate within the housing when a torque is applied by the key to unlock the lock.

[0002] Wafer-tumbler locks have wafer-shaped tumblers which slide up and down within channels that extend from the cylinder to the housing. The wafer tumblers are spring loaded so that they can extend out of the cylinder and into a locking slot within the housing, thereby preventing rotation of the cylinder relative to the housing in a locked position. The center of each of the wafer tumblers has an opening for receiving a key. The correct key moves the wafer tumblers out of the locking slot, such that torque applied to the cylinder rotates the cylinder within the housing and unlocks of the lock.

[0003] To avoid or reduce the costs of changing or re-keying locks in office and apartment buildings, for example, several types of re-keyable locks that do not require disassembly have been developed for pin-tumbler locks, see, for example, U.S. Patent Nos. 4,412,850 and 5,233,850. Simple and cost-effective re-keyable locks for wafer tumbler systems are still needed.

SUMMARY

[0004] One embodiment of the invention provides a re-keyable lock and method. The lock has locked and unlocked positions and may include a housing and a cylinder rotatably supported in the housing and having a plurality of channels. The lock includes a plurality of wafer tumblers resiliently supported in the corresponding channels. Each wafer tumbler has a rider element selectively engaged with a base element in first and second engagement positions, wherein the first engagement position corresponds to a first key and the second engagement position corresponds to a second key. The lock also includes a re-keying slot on a face of the cylinder such that a re-keying tool can be inserted in the slot when the cylinder is in a learn position to disengage each rider element from the corresponding base element in the first engagement position to enable re-engaging the rider element to the base element in the second engagement position. In this manner, the lock may be re-keyed without disassembly of the cylinder assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] In the accompanying Figures, there are shown present embodiments of the invention wherein like reference numerals are employed to designate like parts and wherein:

[0006] FIG. 1 is an exploded perspective view of an embodiment of a lock according to the present invention;

[0007] FIG. 2 is a exploded perspective view of a longitudinal section of the lock of FIG. 1;

[0008] FIG. 3 is an assembled perspective view of a longitudinal section of the lock of FIG. 1;

[0009] FIG. 4 is a sectional view of the lock showing an embodiment of a first wafer tumbler in a locked and engaged position;

[0010] FIG. 5 is a sectional view of the lock showing the first wafer tumbler of FIG. 4 in an unlocked and disengaged position;

[0011] FIG 6 is a sectional view of the lock showing an embodiment of a second wafer tumbler in a locked and engaged position; and

[0012] FIG. 7 is a sectional view of the lock showing the second wafer tumbler of FIG. 6 in an unlocked and disengaged position.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Referring now to the drawings for the purpose of illustrating the invention without limiting the same, it is to be understood that standard components or features that are within the purview of an artisan of ordinary skill and do not contribute to the understanding of the various embodiments of the invention are omitted from the drawings to enhance clarity and are not described. In addition, it will be appreciated that the characterizations of various components and orientations described herein as being "vertical" or "horizontal", "right" or "left", "side", "top" or "bottom", are relative characterizations only based upon the particular position or orientation of a given component for a particular application.

[0014] FIG. 1 is an exploded view of an embodiment of a re-keyable lock 100 according to the invention. The lock 100 includes a cylinder 102, which rotates in a housing 104. The cylinder 102 has a plurality of first channels 106 as best see in FIGS. 2 and 4. The first channels 106 are sized to receive a first set of wafer tumblers 108. Each first wafer tumbler 108 includes a base element 110 and a rider element 112. As presently preferred, each base element 110 is a substantially flat plate that has an opening 114 that allows a key 120 to be inserted into the lock 100. In one embodiment, the base element 110 may have a lower portion 122, which may be U-shaped and have two legs 124 as best seen in FIG. 4. The legs 124 may be received in corresponding cavities 126 that extend from the corresponding first channel 106. The base element 110 is resiliently supported in the corresponding first channel 106 by any resilient mechanism, such as, for example, by two springs or coils 128 that are received

in the cavities 126. The springs 128 bias the base element 110 toward the housing 104 and away from the cavities 126 to a "locked position", shown in FIG. 4, in which the cylinder 102 cannot turn relative to the housing 104, as is explained below.

[0015] Each base element 110 includes a plurality of engagement formations, such as slots or tabs, 130. Each rider element 112 may have an open frame that is supported on a corresponding base element 110 . The rider element 112 includes a top portion 134, an engagement arm 136, and a support arm 138. The engagement arm 136 includes one or more engagement formations, such as tabs or slots, 132, that are engagable with one of the engagement formations 130 of the base element 110. The support arm 138 may contact a portion of the base element 110 providing additional stability for the rider element 112. The top portion 134 of the rider element 112 may be biased by the spring-loaded base element 110 into a locking slot 140 in the housing 104, thereby locking the lock 100 and preventing the cylinder 102 from rotating relative to the housing 104. The locking slot 140 is appropriately sized and shaped to receive the upper portion 134 of the rider element 112 in the locked position.

[0016] The engagement slots 130 of the base element 110 are spaced at distances that correspond to standard sizes of biting 132 in the key 120. As is well-known in the art, the sequence of biting sizes determines the proper key for a lock. Conventionally, each biting size is designated by an integer number. For a lock with seven wafer tumblers, for example, a sequence of seven digits

determines the locking combination of the key. The sequence "1212121", for example, includes three biting of size 2 and four biting of size 1. By way of example, when the rider element 112 is provided with one engagement tab 132, and the base element 110 is provided with six engagement slots 130, each wafer tumbler 108 may assume any one of six positions corresponding to six different biting numbers. When the rider element 112 is provided with two tabs 132 for six engagement slots 130, then each first wafer tumbler 108 may assume any one of five positions corresponding to five different biting numbers. In the embodiment shown in FIG. 4, the rider element 112 is provided with three engagement tabs 132 for the six engagement slots 130 of the base element 110, and therefore the first wafer tumblers 108 for this embodiment may assume any one of four positions corresponding to four different biting numbers. In general, the number of different biting numbers available for each wafer tumbler 108 is determined by the number of available positions in which the engagement tabs 132 can be placed into the engagement slots 130. Assuming that the number of slots N2 is greater than the number of tabs N1, the number of available positions is N2 - N1 + 1.

[0017] It should be appreciated that the shapes of the engagement tabs 132 and the engagement slots 132 do not have to be rectangular, as is shown in the embodiment of FIG. 4. Other shapes, including curves and straight lines may also be used. Furthermore, the placement of the engagement tabs 132 and engagement slots 130 may be interchanged, i.e., the engagement tabs 132 may be placed in the base element 110 and engagement slots 130 may be

placed in the rider element 112. A periodic pattern of tabs 132 alternating with slots 130 may also be used in both the engagement arm 136 and the base element 110, as shown in FIG. 4.

[0018] As presently preferred, the engagement arm 136 is a flexible element that includes a flange 142 extending from an end 144 that is adjacent to the tabs 132. By exerting a force against the flange 142, the engagement tabs 132 of the rider element 112 may be disengaged from the engagement slots 130 of the base element 110 to allow re-keying the lock 100 as is described below.

[0019] The cylinder 102 includes a face 146 having a keyway 148 and a re-keying slot 150. The re-keying slot 150 may be sized to receive a re-keying tool 152. The re-keying tool 152 is a long rod, which, when inserted into the re-keying slot 150, pushes against the flange 146 and the base element 110 causing the engagement arm 136 to deflect, and thereby prying the engagement tabs 132 out of the engagement slots 130. The re-keying slot 150 may be positioned relative to cylinder 102 such that the re-keying tool 152 may engage the flange 142 when the original correct key 120 is inserted in the keyway 148 to rotate the cylinder 102 into an position as shown in FIG. 5. In the unlocked position, each wafer tumbler 108 may be completely received in the corresponding first cylinder channel 106, i.e. all the top portions 136 are disengaged from and are out of the first locking slot 140 of the housing 104, such that there is no interference in the rotation of the cylinder 102 relative to the housing 104.

[0020] The re-keying slot 150 may have, for example, a T-shaped cross-section and the tool 152 may also have a T-shaped cross-section. The flange 154 of the tool 152 may push against base element 110, while the web 156 of the tool 152 pushes against the flange 142 of the rider element 112, thereby disengaging the rider element 112 from the base element 110. The re-keying tool 152 is preferably tapered along its length to facilitate disengagement of the rider elements 112 from the base elements 110. While the present invention has been described with reference to a re-keying tool which is separable from the lock 100, one skilled in the art will recognize that similar structure which is integral with the lock could be utilized to provide the described re-keying function.

[0021] The lock 100 is re-keyed by the following procedure. Initially, the rider elements 112 are engaged with the base elements 110 in a first engagement position that corresponds to a first key 120, e.g., the original unlocking key 120, as shown in FIG. 4. The first key 120 is inserted in the keyway 148 and the cylinder 102 is rotated to unlock the lock 100 as shown in FIG. 4, thereby placing the lock 100 in a learn mode. In this state, the lock 100 may be re-keyed by insert in the re-keying tool 152 in the re-keying slot 150 such that the engagement arm 136 of the rider element 112 is disengaged from the base element 110. The first key 120 can be removed and a second key inserted in the keyway 148. The tool 152 is then removed, forcing the rider elements 112 to engage the base elements 104 in a second engagement position that is

determined by the biting 132 of the second key, thereby re-keying the lock 100 for the second key.

[0022] As illustrated in the Figures, the lock 100 includes a second set of wafer tumblers 108a received in corresponding second channels 106a in the cylinder 102. The second wafer tumblers 108a are similar to first wafer tumblers 108 described above and thus their description will not be repeated. Elements of the second wafer tumblers 108a corresponding to similar elements of the first wafer tumblers 108 are indicated by the same reference numbers followed by the letter "a". For example, each second wafer tumbler 108a may include a rider element 112a and a base element 110a, etc. As best seen in Figure 2, the second channels 106a are interlaced with the first channels 106 and the first and second wafer tumblers 108, 108a are positioned such that the engagement arms 136, 136a are on opposite sides relative to the keyway 148 of the lock 100. As an example, seven first wafer tumblers 108 and six second wafer tumblers 108a are shown in the embodiment of FIG. 1. However, one skilled in the art will recognize that the number and location of water tumblers in a given lock may vary depending on the requirements of the particular application.

[0023] The rider elements 112a of the second wafer tumblers 108a are disengaged from the corresponding base elements 110a by inserting a second re-keying tool 152a through a second re-keying slot 150a on the face 146 of the cylinder 102 in the unlocked position as seen in FIGS. 6 and 7. It will be appreciated that the engagement positions of the second rider elements 112a on the second base elements 110a are not dictated by, and thus are independent of

the engagement positions of the rider elements 112 on the base elements 110. Accordingly, the unlocking keys may have either symmetric or non-symmetric biting 132.

[0024] In one embodiment, the first and second base elements 110, 110a and the first and second rider elements 112, 112a may have tapered thickness to facilitate inserting the key 120 in the openings 114,114a of the first and second base elements, respectively, and inserting the re-keying tools 152, 152a in the corresponding re-keying slots 150, 150a as best seen in FIGS. 4 - 7.

[0025] From the above description, it will be appreciated that the invention provides a versatile, cost-effective and convenient re-keyable lock 100. Many combinations of first and second wafer tumblers 108, 108a are possible. Many sequences of engagement formations 130, 132 are also available and may be selected for each wafer tumbler 108, 108a. Therefore, a great number of new keys may be provided for re-keying the same lock 100 without ever having to disassemble it.

[0026] Whereas particular embodiments of the invention have been described herein for the purpose of illustrating the invention and not for the purpose of limiting the same, it will be appreciated by those of ordinary skill in the art that numerous variations of the details, materials and arrangement of parts may be made within the principle and scope of the invention without departing from the spirit of the invention. The preceding description, therefore, is not meant to limit the scope of the invention. Rather the scope of the invention is to be determined only by the appended claims and their equivalents.